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Ground cover and nitrogen management in strawberry cultivation under Swiss humid climate conditions.

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Summary
Strawberry production systems are permanently adapted to changing agroecological and economical circumstances in Switzerland. Alternative ground cover management systems with various mulching treatments are evaluated to reduce herbicide input. Like in other row crops, stripe applications of nitrogen are considered to reduce nitrate leaching. The overall aims of this study were to contribute to an optimized strawberry production system under temperate climate and sandy loam conditions characteristic for Swiss Midlands by minimizing nitrogen application rates and adapting mulching techniques while maximizing fruit yield and quality. For this purpose, the research was structured by looking at the impact i) of various mulching treatments on physical and chemical soil parameters, ii) of these mulching treatments on intermediary crop development parameters, yield and fruit quality, iii) of banded nitrogen fertilization on intermediary crop development parameters, yield and fruit quality and of the interaction of mulching techniques and nitrogen fertilization.

Field experiments
Field experiments were established between 1994 and 1997 with the cvs. Petrina and Mars at Waedenswil (sandy loam, 1400 mm annual precipitation). Different interline ground cover management systems were compared at an intermediate N fertilization rate of 3x20 kg N/ha: Bare ground, black and white water-permeable Mypex films, straw added after planting and living mulch of a not winterhardy white clover accession sown after planting. Within the two latter systems rows were covered by bands of water-permeable black polyethylene plastic film of 30 cm width. In bare ground experiments, stripe nitrogen (N) applications on the planting lines were compared at the following rates: 0 or 10, 20, 30 and 40 kg N/ha applied 3 times, i.e. at 2 weeks after planting, at the initiation of growth in early spring and at the beginning of flowering. The 0, 3x20 and 3x40 kg N/ha treatments were also compared within the interline mulching treatments with the black Mypex films, straw mulch in 1994/1995, 1995/1996, and the slowly growing white clover in 1995/1996. Complete randomized block designs with ground cover management and nitrogen fertilization as combined factors were used (four replicates). Soil temperature, moisture and spatial mineralised nitrogen (Nmin) dynamics were measured during crop development. Intermediary crop development parameters such as runner formation after planting, leaf area per plant and total shoot dry matter after harvest were measured. Moreover concentrations of total N and nitrate in leaf blades, yield, fruit size and fruit quality parameters were assessed.

Ground cover

Black Mypex films accelerated soil warming in spring. The other mulching systems delayed soil temperature increases, which makes them unsuitable for conditions with red stele and black root rot infection pressure. The use of black and white Mypex films affected Nmin values inconsistently if compared to the control treatment with bare ground. Winter straw mulch appears to be most suitable to reduce nitrogen leaching in the interline area during winter on sites with increased Nmin values. The white clover mulch treatment decreased N availability in the planting year.

Ground cover management had a minor effect on leaf area development in contrast to runner formation after planting. Straw and living clover mulches reduced runner and also flower formation possibly due to shading effects. The white Mypex film reduced runner formation as compared to the black sheets, while the number of flowers was increased pointing at a possibly earlier flower initiation due to lower temperatures on and under white sheets. Fruit size showed a little response to the ground cover management treatments. Straw and living clover mulch decreased fruit load but increased soluble solids.

Nitrogen application

Intermediate crop development parameters responded differently from year to year to nitrogen application rates, depending on the apparent Nmin values after planting and during the following harvest year. For instance, runner formation after planting and leaf development were enhanced by increasing nitrogen fertilization rates (cv. Petrina) in a year with low Nmin values after planting (1994/1995), while in an other year

with high Nmin values after planting (1995/1996), leaf area hardly responded and runner formation was even decreased.

In the year with low Nmin values after planting nitrogen application rates had no effects on generative growth (flower formation), contrary to vegetative growth, pointing at its minor priority among nitrogen sinks. In the year with high Nmin values after planting very high nitrogen rates even inhibited the vegetative growth causing salt stress-like symptoms on the leaves. Quick leaf nitrate tests appear to be useful for assessing the momentaneous nitrogen requirements of strawberry plants in the harvest year when nitrogen demands are high. Nitrogen demand values have to be determined yet for the most important cultivars. Fruit quality (soluble solids and firmness) was negatively affected by the highest nitrogen application rate. It can be concluded that only low nitrogen rates are required for supporting crop development and a desired fruit quality by stripe application on to rows. Optimally, the rates should be flexibly adapted to the predominant Nmin values after planting in the respective year.

Recommandations

Based on these studies, black and white plastic mulches may be recommended under temperate climate and sandy loam conditions for optimizing crop development and fruit quality. In contrast, interline straw and not winterhardy living white clover mulch seem to be deleterious to crop development in flat strawberry planting systems under the studied agroecological conditions. Concerning nitrogen fertilization and its interaction to ground cover management, it can be concluded that with regard to fruit yield and quality moderate N applications directed on to rows meet the demand of strawberry plantations best.

Literature

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